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Science Advisory Report 2007/030

ASSESSMENT OF GASPEREAU RIVER ALEWIFE

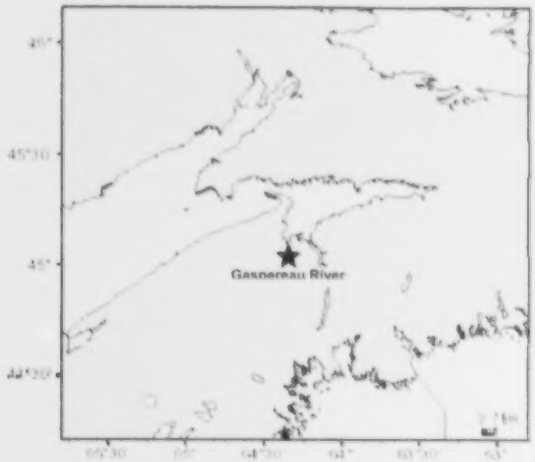

Figure 1: Location of the Gaspereau River, Nova Scotia

Context

The anadromous alewife (Alosa pseudoharengus) population of the Black River – Gaspereau River, Nova Scotia supports both recreational and commercial fisheries of local importance. There is not a blueback herring (Alosa aestivalis) run in this river. Landings from the recreational fishery are not reported but are not considered to be significant in comparison to the total annual harvest from the commercial fisheries. All fisheries target adult alewife as they migrate upstream through the estuary and river to spawn in lakes during May-June (Gibson and Myers 2001). Commercial fishing occurs with gillnets in tidal waters and with a weir and dip-net apparatus (Jessop and Parker 1988) - known locally, and defined in regulations, as a square-net - in non-tidal waters.

Extensive modification to the Black River – Gaspereau River watershed has occurred during the past 80 years in order to facilitate hydroelectric generation. Fish ladders, diversion screens, spillways and control gates are used by Nova Scotia Power Inc. (NSPI) to limit the impact of hydroelectric generation on alewife (and other species), most notably by facilitating access to spawning habitat and by discouraging downstream passage of both young-of-the year, and post-spawned adults through the four turbines located on the Black River. Recent upgrades include installation of downstream bypass facilities around the fifth turbine on the system which is located in the lower most dam at White Rock and relocation/replacement of the timber fishway at White Rock with a concrete fishway, located ~2 km upstream of White Rock. These facilities became operational in time for the 2002 spawning season and have remained operational since.

A five-year fishery management plan came into effect for the start of the 2002 season with the goal of meeting a spawning escapement target of 400,000 adults through a reduction of potential fishing activity. This target is the spawning escapement that corresponds with maximum sustainable yield at an exploitation rate of 63%. The reduction in fishing activity was achieved by an additional closed day to fishing, effectively reducing potential fishing activity a further 14% to 57%. This assessment was conducted to review the status of the population upon the fifth year following implementation of the new fishery management plan.

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SUMMARY

- A five year fishery management plan came into effect for the start of the 2002 season with the goal of meeting a spawning escapement target of 400,000 adults through a reduction in fishing mortality.
- Concurrent with the implementation of the fishery management plan in 2002, several changes were made to fish passage facilities on the Gaspereau River system.
- Average annual catch of 315,639 fish during 2002-2006 is below the average catch of 609,276 fish for the five years previous to the implementation of the management plan.
- Average exploitation rate during 2002-2006 is 53.6%, which is lower than both the average exploitation rate during 1997-2000 (83.2%) and the corresponding exploitation rate of 63% at MSY.
- Average total run size for 2002-2006 (594,918) is lower than for 1997-2000 (721,097).
- Average escapement for 2002-2006 has increased approximately two-fold (279,278) compared to escapement for 1997-2000 (111,823).
- The spawning stock of this population depends primarily upon age 4 and 5 year old spawners and the percentage of repeat spawners has not increased.
- There are no indications that either alewife longevity or frequency of repeat spawning has increased in response to the decrease in exploitation and changes in fish passage that came into effect concurrently in 2002.
- Recruitment of age four spawners in 2006 was low.
- The effect of the fishery management plan aimed at reducing exploitation, possibly in conjunction with natural variability in water flow, has reduced exploitation and increased escapement. The collective effects of the water, fishery, and fish passage management changes within the watershed are not known.
- Escapement remains below the five-year management objective of 400,000 spawners, an outcome which is partially attributable to low total run sizes and a minimal four to five year lag time in an observable response (i.e., an increase in recruitment).
- Caution is advised in making changes to the existing management regime.

BACKGROUND

Species Biology

The adult alewife's spawning migration typically begins in late April or early May, peaks in late May or early June and is completed by late June or early July. Spawning occurs in headwater lakes, stillwaters and back eddies. Adults return to the sea shortly after spawning. Young-of-the-year remain in fresh water for the summer and early autumn before migrating to the sea where they remain until they recruit to the spawning stock. First spawning typically occurs at

age 3 and virtually all fish have spawned by age 6. Alewives can live to over 10 years of age, and may spawn 5 or more times during their life.

Fishery

The alewife population of the Gaspereau River supports both recreational and commercial fisheries of local importance. Landings from the recreational fishery are not reported and are not considered to be significant in comparison to the total annual harvest from the commercial fisheries. All fisheries target adult alewife as they migrate upstream through the estuary and river to spawn in lakes during May-June. Commercial fishing occurs with both set and drift gillnets in tidal waters and with a weir and dip-net apparatus (Jessop and Parker 1988) - known locally, and defined in regulations, as a square-net - in non-tidal waters.

Landings from the commercial fishery have been reported, since 1986, through a mandatory fisher logbook program (Fig.2). Return of logbooks has been a condition of licence since 1990, yet return rates have averaged only 76% among years (Fig.2). Prior to the implementation of logbooks, catch statistics were collected by fishery officers via sales slips and Supplementary As and Bs (fishery officer estimates of sales and personal uses not recorded by sales slips). However, up to the end of the 2005 season, local fishery officers continued to acquire annual harvest estimates by counting the number of 50 pound pails of packed fish during site visits to individual licence holders. This assessment continues to use pail count data as the principle means to estimate catch in order to maintain consistency with the 2001 assessment (Fig.3).

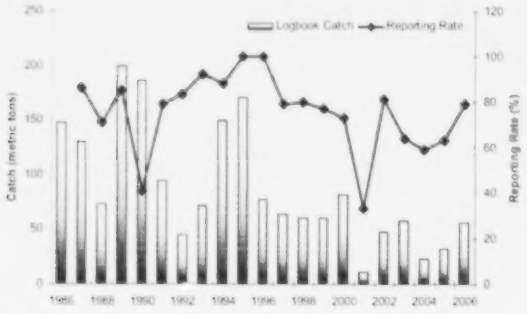

Figure 2. Catch as reported by fisher returned log books and logbook reporting.

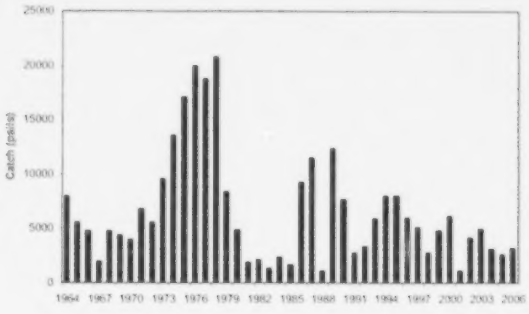

Figure 3. Catch estimates of alewife on the Gaspereau River from fishery officer pail counts (one pail contains between 100 and 133 fish).

To estimate pail counts in 2006, a 'kilogram-to-pail' conversion factor was estimated by comparing the reported catches of seven fishers who have consistently returned their logbooks since 1986 with the fishery officer estimated pail counts, converted to kilograms, for these same fishers.

ASSESSMENT

Escapement and Run Size Trends

After escaping the fishery, the spawning run must ascend two fish ladders (White Rock and Lanes Mills fish ladders) prior to reaching Gaspereau Lake. Fish passage has been monitored at the White Rock fish ladder in the years 1970, 1982-84, 1995, and 1997-2006. Prior to 2002, when the new fish ladder was constructed at White Rock, hand counts of the fish were

performed as the fish ascended the fish ladder. With construction of the new fish ladder, an assessment facility was put in place at the top of the fishway. This facility houses a video monitoring system that records the passage of fish as they ascend the ladder. Video recording of fish passage was implemented in time for the 2002 spawning season.

Count data from 1997-2002 represent absolute counts of escapement (Fig. 4). During the 2002 spawning run, fish passage was determined by complete counts from recorded video of the run, as well as hand counts on days missed due to camera malfunction. Count data for 2003-2006 are estimates of fish passage (Fig. 4). The stored video files for 2003 were all reviewed to obtain complete counts, however, days missed due to camera malfunction required interpolation to estimate the fish passage on these days. Video files from 2004 to 2006 were subsampled to estimate total fish passage. Interpolation was used in these years to estimate fish passage on days where fish were not counted due to camera malfunctions.

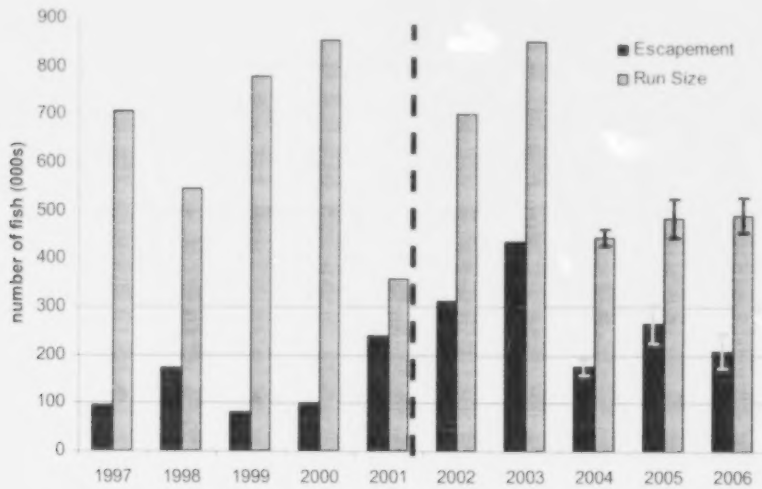

Figure 4. Annual spawning escapement counts and total run size. Error bars represent 95% confidence interval for subsampling estimates of escapement. There is no estimate of error around interpolated values. Dashed line indicates the point at which the fishery management plan was implemented and changes were made to fish passage facilities.

A five year fishery management plan came into effect for the start of the 2002 season with the goal of meeting a spawning escapement target of 400,000 adults through a reduction in fishing mortality. As seen in Figure 4, an increase in escapement from the fishery through the White Rock fishway has occurred since the additional one day closure of the fishery and the relocation/construction of the new fishway, both of which occurred previous to the start of the 2002 spawning run.

The number of alewives in the Gaspereau River spawning run (Fig. 4) is estimated by converting annual catch in pails to the number of fish in the catch and then adding it to the annual escapement count. Run size has been variable over time and relatively low in recent years.

Exploitation

Exploitation rates were calculated for each year where both fish counts and commercial catch were available (Table 1). Exploitation rates have decreased since the implementation of the

fishery management plan and new fish passage facilities, which occurred concurrently, prior to the start of the 2002 fishing season.

Table 1. Exploitation rates for 1997-2006.

Year	Exploitation Rate (%)
1997	86.5
1998	68.5
1999	89.6
2000	88.4
2001	33.3 *
2002	55.7
2003	48.9
2004	60.6
2005	45.2
2006	57.5

** Exploitation rate for 2001 is low due to flooding during fishing season.*

Biological Information

Biological samples were collected from fish as they ascended the White Rock fish ladder every year from 1997 to 2006. Fish were measured and weighed, examined to determine sex, and scales were removed for determination of age and spawning history.

All biological characteristics measured for this stock have not changed significantly over time. The biological characteristics are summarized as 5-year averages prior to and post implementation of the fishery management plan and the new fish passage facilities, which occurred concurrently prior to the start of the 2002 fishing season (Table 2). Characteristic values for 1997-2001 are not significantly different from those for 2002-2006

Table 2. Biological characteristics of the Gaspereau River alewife stock.

	5-year averages (SD)	
Biological Characteristic	**1997-2001**	**2002-2006**
mean fork length	253.9 (4.7)	258.5 (6.0)
max fork length	302.6 (11.3)	305.6 (13.1)
mean weight	226.7 (14.9)	240.0 (16)
mean age	4.4 (0.2) *	4.3 (0.2)
max age	6.6 (0.5)	6.6 (0.5)
mean age 1st spawners	4.3 (0.2) *	4.1 (0.3)
mean age repeat spawners	5.2 (0.2) *	5.1 (0.2)
% repeat spawners	14.3 (6.3) *	16.4 (5.9)

** 2003 data was not included in averages due to a lack of complete age data for this year.*

Spawning in the stock remains dependent primarily upon two year classes, 4 and 5 year olds and the percentage of repeat spawners has not increased.

The number of four year old recruits estimated to have returned in 2006 was lower than expected given the high escapement in 2002.

Current Status

The current status of the Gaspereau River alewife stock can be summarized by comparing 5-year averages prior to and post implementation of the revised management plan and improvements to fish bypass facilities that came into effect concurrently in 2002. The year of reduced fishing activity in 2001 due to flooding was eliminated from these averages. The average annual catch for 2002-2006 is below the average catch for 1997-2000 (Table 3). These recent five-year averages are lower than the long term average catch for 1964-1996.

Average escapement for 2002-2006 has increased approximately two-fold, to 279,278, compared to escapement for 1997-2000 (111,823). Average total run size for 2002-2006 is lower than for 1997-2000 (Table 3).

Exploitation rate since 2002 has averaged 53.6%, which is lower than the average exploitation rate during 1997-2000 (83.2%).

Table 3. Long-term mean catch, and 5 year means of stock characteristics for time periods prior to and post implementation of the revised management plan and improvements to fish bypass facilities that came into effect concurrently in 2002. 2001 is not included as it was a flood year.

Time Period	Catch		Escapement	Run Size	Exploitation Rate
	Pails ± SD	# of fish	# of fish	# of fish	%
1964-1996	7,413 ± 5,476	-	-	-	-
1997-2000	4,706 ± 1,402	609,276	111,823	721,097	83.2
2002-2006	3,430 ± 1079	315,639	279,278	594,918	53.6

Sources of Uncertainty

Three different sampling protocols were used during 2001-2006 to acquire information on the biological traits of the annual runs of alewife to the river. Of these, only the 2001 sampling protocols were the same as used by Gibson and Myers (2001) to assess population status for 1997-2000, and to develop the escapement target. The change in sampling protocols may have influenced the precision of the estimates of numbers at age, spawning history, and total landed catch (i.e., pail to number of fish conversions based on fish weights).

CONCLUSIONS AND ADVICE

The 14% reduction in potential fishing activity that came into effect in 2002 reduced the exploitation rate of the fishery to 53.6% from 83.2% during 1997-2000. This is lower than the corresponding exploitation rate of 63% at MSY estimated for the Gaspereau River alewife stock by Gibson and Myers (2003).

Escapement past the fishery has increased on average by nearly a factor of two relative to 1997-2000. Escapement remains below the five-year management objective of 400,000 spawners, an outcome which is partially attributable to low total run sizes and a minimal four to five year lag time in an observable response (i.e., an increase in recruitment). The effect of the fishery management plan, aimed at reducing exploitation, and possibly in conjunction with natural variability in water flow, has reduced exploitation and increased escapement. The collective effects of the water, fishery, and fish passage management changes within the watershed are not known.

There are no indications that either alewife longevity or incidence of repeat spawning has increased in response to the decrease in exploitation and changes in fish passage that came

into effect concurrently in 2002. Recruitment to the Gaspereau River adult population can occur as early as age three, most do not mature until ages four and five, with full recruitment to the adult population (and fishery) at age six. Therefore, 2006 was the earliest year that a measurable positive response, in terms of increased recruitment, to the reduction in exploitation, could be anticipated. Recruitment of age four spawners in the most recent year was low. These points may warrant particular attention during the next few years. There may be cause for concern with post-escapement and/or post-spawning survival should these characteristics not increase, in response to the changes made in 2002. Caution is advised in making changes to the existing management regime.

MANAGEMENT CONSIDERATIONS

Future assessments on the status of the Gaspereau River alewife stock will be dependent on reported logbook data for information regarding catch in the commercial fishery. This is critical to estimating the exploitation rate for this fishery. Fisheries management should ensure that there is timely and accurate submission of logbook records in compliance with licence conditions.

OTHER CONSIDERATIONS

In the Maritimes region, a number of alewife and blueback herring populations are managed. Concerns with the status of these populations, and the fisheries they support, have been expressed by stakeholders at management advisory meetings conducted since 2004. These concerns may indicate a general decline in alewife status has occurred within the Maritimes region since the last Gaspereau River alewife assessment in 2001. This assessment does not, and owing to data deficiencies, cannot incorporate broader regional considerations into the formulation of science advice. The potential role of in-river versus regional influences on run strength (beyond fishing effects) and post-spawned survival can therefore not be evaluated at this time.

SOURCES OF INFORMATION

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